technology was very similar to that of their modern human contemporaries, they cared for their injured, and we have yet to last as long as a species on this planet as they did. However, modern humans went on to develop symbolic representation, complex social organisation, and also language in a way that was probably unmatched by the Neandertals. In the end, the nature of our speculations about what happened to the Neandertals may say more about us and how we see the current world than about what really happened 30,000 years ago. Some are convinced that Neandertals were the victims of an early genocide by modern humans — a consequence of our inherently violent nature. However, in the Middle East Neandertals and modern humans overlapped in the same general area for over 50,000 years and must at least have met some times — a fact that can be regarded as an encouraging example of long-term coexistence between two different forms of humans.

Where can I find out more?

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Book review

Professor Jekyll and Comrade Hyde

Walter Gratzer

J.D. Bernal – The Sage of Science
Andrew Brown
(Oxford University Press, Oxford)
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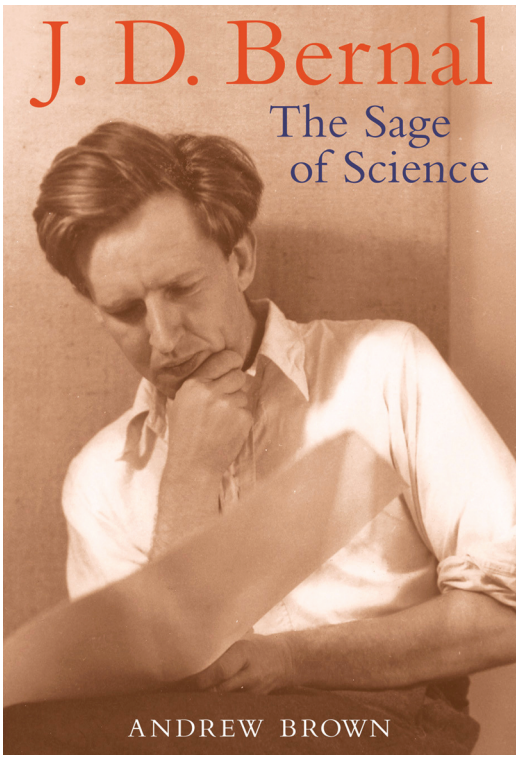
"For 50 years he has, over and over again, astounded the scientific world by his extraordinarily original and fertile concepts, which show a depth of understanding and brilliance of thought possessed, in my opinion, by no other living man. He is one of the greatest men in the world." This from Linus Pauling, who was not noted for shows of deference to even the most illustrious of his confrères. John Desmond Bernal was indeed a genius. He illuminated each of the many territories of science on which he set foot, and he left his imprint on history. A rewarding subject, then, for a biographer, and Andrew Brown has made the most of it.

Bernal sprang from Irish farming stock, but with a dash of French and of Jewish blood. He shocked his family with an early display of independence when he came out for Sinn Fein, but it was only in Cambridge, among the youthful left-wing patriciate, that he experienced a true transfiguration: the strict Catholicism in which he had been reared was supplanted by an even more fervent belief in communism and the brotherhood of man. In Cambridge, also, following a relatively unpropitious start reading mathematics, he was drawn to physics, captivated mainly by the principles of symmetry. He failed to achieve a First because, Brown suggests, he had laboured mightily to derive the 230 symmetry space groups. This secured him a University prize — shared with R.W.G. Norrish, Nobel Laureate to-be, and the hated research supervisor of Bernal's future protégée, Rosalind Franklin — but without a First there could be no place for him in the hub of physics, Rutherford's Cavendish Laboratory (nor did his Lordship tolerate political activists in his realm). But Bernal's supervisor of studies recognised his qualities and commended him to Sir William Bragg, director of the Royal Institution in London. There, he quickly gave evidence of the preternatural originality and quickness of grasp that were to mark his career. His first achievement was to uncover the structure of graphite and explain its properties. In between he found time to publish a book, *The World, the Flesh and the Devil*, an extended essay in futurology, which Arthur C. Clarke has called "the most brilliant attempt at scientific prediction ever made" and one that inspired many of his own conceits. This was followed a year later by *Unholy Alliance*, a philippic against the Church.

Bernal had acquired the nickname of 'Sage', from his all-embracing learning and seeming infallibility, while still an undergraduate, and Sage he remained to his friends throughout his life. It may also have been the spontaneity, the luminous intelligence and the sparkle of his conversation that made him so irresistible to women; his sexual appetites indeed appeared unquenchable. At a later stage of his life, his secretary and the wife of his friend and collaborator, Isidore Fankuchen, formed themselves into an exclusive society of 'Women who have never been to bed with Sage', one as president, the other as treasurer. But it was not long before Mrs Fankuchen received a cable announcing that she was henceforth president *and* secretary. Even after Sage's first stroke he charmed and bedded the much younger wife of his actor friend, Miles Malleson, and Brown has unearthed a touching letter that she sent Bernal when he was dying, attended by his three 'wives' (to the first of whom he was legally married). After serving

his time under Bragg's benign regime, Bernal returned to Cambridge, where he joined an illustrious circle of communist intellectuals, some of them destined to die in the Spanish civil war, but he could not gain a firm foothold in the Cavendish. His attempt to secure a college fellowship was rebuffed. In Max Beerbohm's Oxford novel, *Zuleika Dobson*, there appears an imperishable passage: "The dullard's envy of brilliant men is always assuaged by the suspicion that they will come to a bad end". So it was for Bernal, although the donnish excuse was that no man "with hair like that can be *sound*". He accepted instead a call to the Chair of Physics at Birkbeck College in London. His interests now embraced the structure of metals, of proteins — he obtained the first ever X-ray diffraction diagram from a protein crystal — and other biological molecules, and a conversation with the Cambridge theoretician, Ralph Fowler, had ignited an enduring interest in the nature of liquids, especially water. In 1934 Bernal appeared, in the transparent guise of Constantine, the crystallographer and possessor of "the most original, the wildest mind in England", in C.P. Snow's widely praised novel of science, *The Search*.

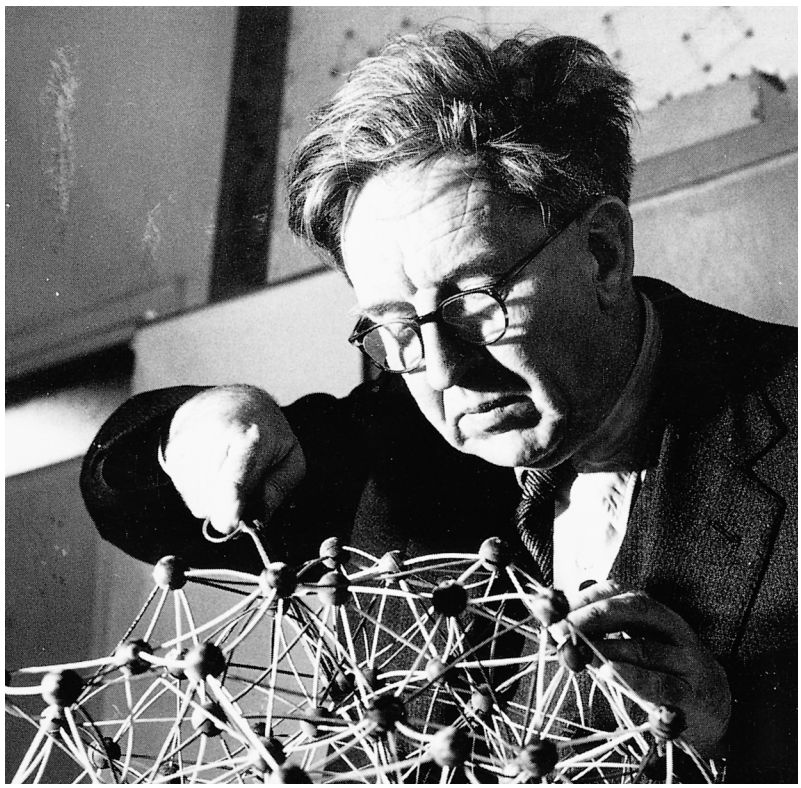
But Bernal cleaved to the Marxist doctrine that science must be subservient to the needs of society, and began to concern himself with problems of civil defence in the impending war. In 1939 he set out his beliefs in a hugely influential book, enthusiastically received even in America, with the title, *The Social Function of Science*. It set off a debate with the defenders of academic freedom — to Bernal a delusion — led by A.V. Hill and later by the physical chemist and philosopher, Michael Polanyi, a scientific friend and political adversary. Bernal, at all events, while still running his department and engaging in interminable political altercations, threw himself into an investigation of the effects of high explosive and incendiary bombs on people and buildings, and the construction of shelters. He was responsible for the design of the ubiquitous Anderson shelter, and notably for the technique of steaming out the charges from the unexploded bombs that littered the cities of Britain when the blitz came, revealing himself, then as later, as utterly fearless. When observing the effects of explosions a colleague noticed that Bernal did not duck into the prepared trench until a moment after the detonation; when taxed with recklessness he replied that he knew exactly the interval between the explosion and the arrival of shell fragments at the position of his head.



The cover of *J.D. Bernal —The Sage of Science* by Andrew Brown (reproduced with kind permission of Oxford University Press).

As the war progressed Bernal struck up an improbable rapport with the playboy admiral, the flamboyant and vainglorious Commander of Combined Operations, Lord Louis Mountbatten, and was drawn into a series of demanding activities that took him to all parts of the world. His most celebrated achievements surrounded Operation Overlord, the Allied invasion of France in 1944. He designed the bomb-resistant portable harbours (code-named Mulberry), essential for landing supplies, and it was he who sought out places where landing-craft might be beached and tanks and other vehicles driven ashore. For this he made painstaking measurements on aerial photographs, and examined travel guides and Roman and medieval documents which divulged where beaches had the desired slope and the sand was supported by peat. Without such meticulous analysis the troops would almost certainly have fared much worse. Bernal himself, in an ill-fitting navy uniform, crossed on D+3 to gather information, and characteristically managed to take time out to examine an ancient church in Caën, for church architecture was one of his passions.

The war over, Bernal returned to his physics department, housed now in two mouldering and bomb-ravaged terrace houses in Bloomsbury. He and his current 'wife', before she despaired of his chaotic lifestyle and moved out, occupied the servants' quarters on the top floor of one. Students in the laboratory were instructed to cover their ears when they heard pairs of footsteps ascending the rickety staircase above the laboratory. In addition to the work on inorganic crystals, on proteins and especially now on



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viruses, Bernal discovered a new interest — the origin of life – but, true to his principles, he also set up a group to study the properties of concrete, which were proving a problem to the hard-pressed post-war building trade. He was called upon to undertake a study of how best to construct prefabricated houses and was in demand on other advisory bodies. As if this were not enough he collaborated in the establishment of UNESCO, was active in the Association of Scientific Workers, was elected vice-president of the newly founded World Federation of Scientific Workers while already holding the same office in the Soviet-funded World Peace Council, played his part in setting up the International Union of Crystallography, lectured (in French) at a conference in Paris to mark the 50th anniversary of Pasteur's death, and travelled ceaselessly. And then, in 1954, there appeared the first edition of his magisterial opus (which by the time of the third edition ran to four volumes), *Science in History*.

Not surprisingly, Bernal's scientific output dwindled, although the flow of ideas never ceased, but his political utterances became ever more strident. He endorsed the charlatanism of Lysenko, and turned a blind eye to the catastrophic mismanagement of Soviet agriculture, that led to the death by starvation of many millions. He appeared untroubled by the Moscow show-trials and by the arrest and death in prison of his friend, Russia's leading agronomist and plant geneticist, Vavilov, denounced by Lysenko, and the execution of many other leading Soviet scientists. On one of his many visits to Moscow he delivered himself of a scandalous diatribe in praise of the "great leader and protector of peace and science, Comrade Stalin". This was too much for politically moderate scientists, such as Sir Edward Appleton, who referred to "two Professor Bernals", and for many observers like George Orwell, who expressed his views of Bernal in trenchant terms.

Yet Bernal was withal a warm, compassionate and generous man. Francis Crick found him the first genius he had met with consideration for others. To his friends he was loyal to a fault. He defended C.P. Snow against a famously intemperate attack by the literary scholar, F.R. Leavis. He cleaved to a sycophantic *arriviste*, the courtier-scientist, Solly (later Lord) Zuckerman, with whom he had worked through much of the war; his devotion was to be repaid by an outrageous public effusion of jealous bile after Bernal's death. Bernal cherished his three children and remained close to the many women in his life. They all apparently forgave his excesses, and one of the three with whom he shared his life the longest told Andrew Brown that she thought Sage had in truth been faithful after his unique fashion, that "he felt a sort of moral compulsion… to give everybody their turn, you know, and to expect the others to accept it".

But what of Bernal the scientist? His achievements were many and lasting. The greatest was to point repeatedly the direction that X-ray structure analysis should take, giving thereby the prime impulse to the most spectacular undertaking in the biology of the twentieth century. John Kendrew wrote to Bernal, after the award of the Nobel Prizes for the structures of haemoglobin, myoglobin and DNA in 1961: "you've fathered five Nobel Prizes this year alone". Dorothy Hodgkin, Bernal's most illustrious student (and lover), thought it unjust that he had not shared her Nobel Prize. She sensed that he felt dejected when sitting among so many younger scientists with, on the face of it, more tangible successes. His weakness perhaps was his endlessly prolific mind, which robbed him of the patience to pursue to the tedious end any line of inquiry that he had started. Dr Johnson said of Milton that he was "a genius that could cut a Colossus from a rock; but he could not carve heads upon cherry-stones". Bernal was himself a Colossus, and Andrew Brown has written a biography to match. It should stand as a classic.

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